AMERICAN APPLIANCES FOR DEEP-SEA INVESTIGATION. — THE DREDGES.

THE use of dredges for obtaining marine specimens is said to have been suggested by the common oyster-dredge, — a one-sided contrivance, well adapted for the shallow oyster-banks, on which it is skilfully handled by the oyster-fishermen of both Europe and America. This dredge possesses only a single narrow, hoe-like, scraping edge, attached to a light frame above, furnished with rigid handles. The net has a coarse mesh of stout twine, or small interlacing iron rings, the two materials being often combined. This net is too coarse to retain the finer objects, which are as important to the naturalist as the larger; and in even moderate depths there is constant danger of the frame capsizing in its descent through the water.

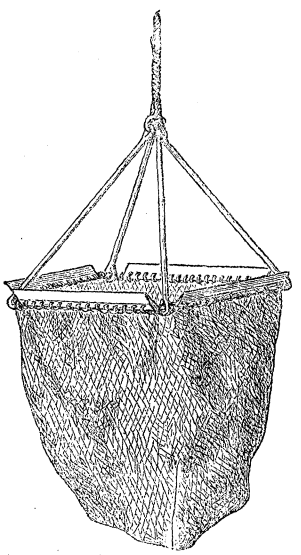

FIG. 1. — OTHO FREDERICK MÜLLER'S DREDGE, A.D. 1750.
(*From 'The depths of the sea,' p. 239.*)

It was these imperfections in the oyster-dredges, unsuiting them for careful work, that led to the changes in the shape of the frame and in the construction of the net, resulting in the production of the perfect yet simple appliance which is now used with as much precision in the deepest parts of the ocean as is the oyster-dredge in its few fathoms of water.

The ordinary dredge.

The dredges adopted by the U. S. fish-commission in 1871, and still employed for all ordinary kinds of work, are of the Ball pattern, but slightly modified. The same pattern has also been used to some extent by the U. S. coast-survey.

The fish-commission dredges are made in two sizes, — the smaller, called the 'boat-dredge,' being suitable for moderate depths of water from small boats, where only hand-power is available for the hauling-in; and the larger, termed the 'deep-sea dredge,' for vessels supplied with steam-hoisting engines. Otherwise than in size, however, these two dredges do not differ from one another. In the deep-sea pattern (fig. 2), the mouth-frame, which is constructed of the best quality of wrought-iron, measures two feet long by five and a half or six inches wide between the hinder edges of the scrapers which form the longer sides of the frame. The latter are two and three-fourths inches wide and a half-inch thick, being bevelled to a sharp edge in front, and are joined to the rounded end-pieces at an obtuse angle, which causes them to flare forward, — an essential feature for most kinds of dredging-work in which it is required that the scrapers should have a strong tendency to dig into, or 'nip,' the bottom. The handles are of round iron, bent double, as shown in the figure, with a loop at the outer end for the attachment of the drag-rope, the lower ends making a single turn about the end-pieces of the frame, upon which the handles move freely.

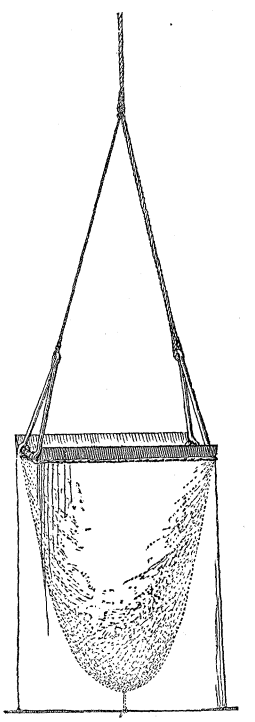

FIG. 2. — THE NATURALISTS' DEEP-SEA DREDGE AS RIGGED BY THE U. S. FISH-COMMISSION.

The net is either a closed bag of strong twine netting, having a finer mesh at the bottom than at the sides, or is made cylindrical in shape, of webbing having three or four meshes to the linear inch, the lower end being tied with a stout cord when in use. To protect the net from wear on rough bottoms, and prevent its bursting open when heavily loaded, it is covered with a bottomless canvas bag a few inches longer than the net itself. To the lower end of this bag and to the end of the net a small round stick is fastened. This is intended to prevent the fouling of the net while being lowered, and also to aid in reversing and emptying it after it has been hauled back upon the deck. It is purposely made of soft wood, in order that it may break without tearing the net if it becomes caught upon the bottom.

The drag-rope proper is tied directly to one handle only, but is connected with the other by means of a rope of much smaller size, which, in case of fouling on rocky bottom, will be the first to part, enabling the dredge to be brought up sidewise, a not unfrequent occurrence.

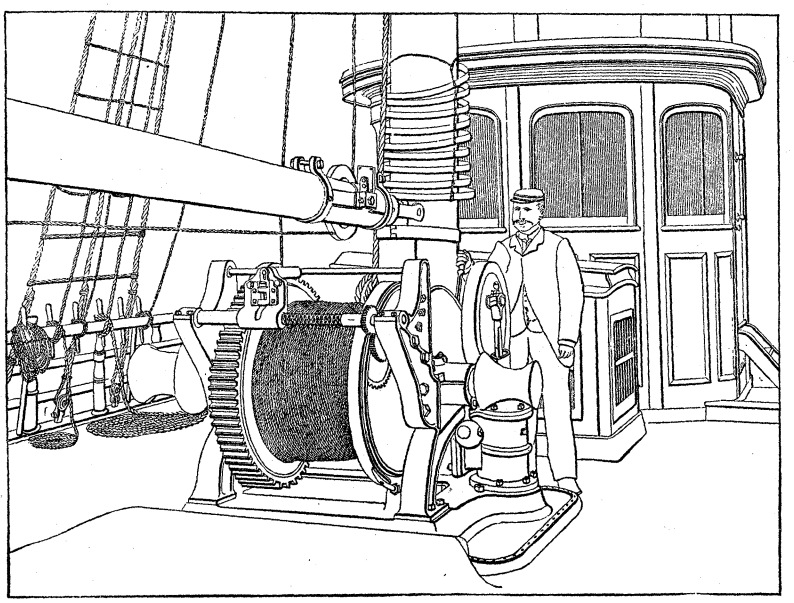

FIG. 3. — THE HOISTING AND REELING ENGINE OF THE U.S. FISH-COMMISSION STEAMER FISH HAWK, SHOWING THE SUPPLY OF WIRE ROPE COILED UPON THE DRUM. VIEW FROM FORWARD, LOOKING AFT.

Such, in brief, is the construction of the most important dredging-appliance of the past, and one which will undoubtedly be continued in use as long as marine explorations are carried on. For all the ordinary purposes of dredging, especially in moderate depths of water, it answers every requirement; its flaring mouth causing it to dig slightly into sandy and muddy bottoms which are not too soft, and to scrape thoroughly over those of rock when not too ragged. It is also cheaply constructed, and therefore within the means of private individuals.

The dredges used by the English Porcupine and Challenger expeditions were of the same pattern, though somewhat more complicated in construction, and much larger and heavier. Judging from the reports of Sir Wyville Thomson, we are also led to believe that they gave much less satisfaction than our own; and, although many of their apparent faults were acknowledged by the director in his 'Depths of the sea,' no very great improvements are noted in the narrative of the Challenger voyage. All of the changes made by these two important expeditions were apparently in the direction of increasing or lessening the

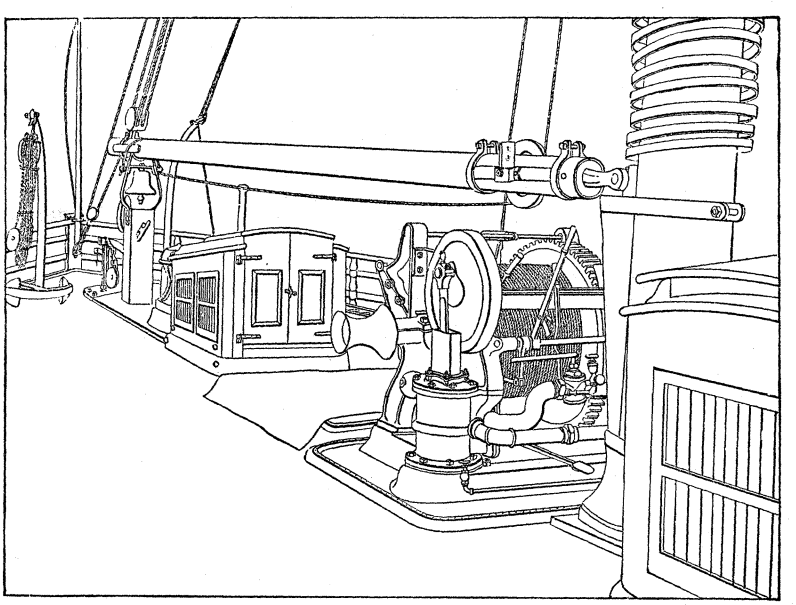

FIG. 4. — THE FORWARD DECK OF THE U. S. FISH-COMMISSION STEAMER FISH HAWK, LOOKING FORWARD FROM THE PILOT-HOUSE, SHOWING THE HOISTING AND REELING ENGINE AND THE DREDGING-BOOM.

weight of the frame, and varying its proportions of length and breadth, the same general shape being always retained. The handles were modified in different ways, and several tangle-swabs were generally attached to the hinder end of the bag.

The Porcupine dredges weighed from a hundred and fifty to two hundred and twenty-five pounds, and the frames were in some cases four and a half feet long. Discussing their merits, Sir Wyville Thomson states, that in many instances he had evidence "that the dredge, instead of falling upon the surface, and then gliding along and gathering the loose things in its path, has fallen upon its mouth, and dug into the tenacious mud, thereby clogging itself so as to admit but little more. I mean to try the experiment of heavier weights and lighter dredge-frames in the Challenger, and I believe it will be an improvement."

It was the fault here mentioned that suggested the construction of the Blake dredge described below, and which is now used by both the coast-survey and fish-commission for the muddy bottoms of deep water.

The Challenger dredge (fig. 6), as figured in the first volume of 'The Atlantic,' was an elaborate affair; and much rigidity was given to the entire appliance by two iron bars extending back, one on either side, from the mouth-frame to an iron crossbar behind the net. This cross-bar afforded attachment for tangle-swabs and weights, when such were desirable; but its main object, in connection with the lateral bars and three loopings about the net, was to keep the latter distended, and prevent its folding over the mouth of the dredge.

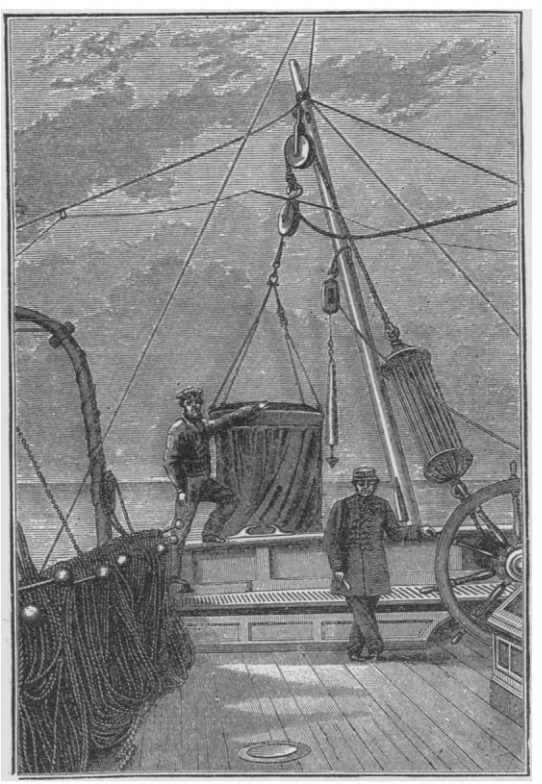

FIG. 5.—THE DREDGING ARRANGEMENTS AT THE STERN OF THE BRITISH SHIP PORCUPINE, SHOWING THE ACCUMULATOR, THE DREDGE, AND THE MODE OF STOWING THE ROPE ON THE 'AUNT SALLIES.'

(*From 'The depths of the sea,' p. 248.*)

We might almost be led to consider that in this device we have a faint suggestion of the more recently invented Blake dredge; yet the two differ radically in construction, and no hint is given, in connection with the former, that a framework might be so constructed as to prevent the undue digging-in of the mouth-scrapers. The dredges used by the Challenger for all excepting the greatest depths were no smaller than those of the Porcupine; the length of the frame being the same as that above given, and the width much greater (fifteen inches).

The Blake dredge.

The difficulty of obtaining good results with the common dredge, on the soft bottoms of mud and ooze which characterize the deeper waters off shore, gave rise to many experiments on the steamer Blake during her first dredging-cruise (1877–78), resulting in the construction of an entirely new pattern (fig. 7), well adapted to this kind of work. The necessity for a change in this direction is well expressed in the above quotation from Sir Wyville Thomson. The whole tendency of the flaring mouth, with so shallow a frame, is to work downwards as well as forwards; though in moderate depths this tendency may be more or less counteracted by a careful manipulation of the drag-rope. The dredge becomes clogged, and its farther progress is of no avail in collecting the objects which live upon the surface of the mud.

The first remedy tried was applied directly to the ordinary dredge, and consisted in 'stopping' a piece of two-and-a-half-inch rope around the hinder part of the frame, thereby correcting to a certain extent the unfavorable

angles of the scrapers, raising their lips, and preventing their cutting so deeply into the mud. Better results were thus obtained; but

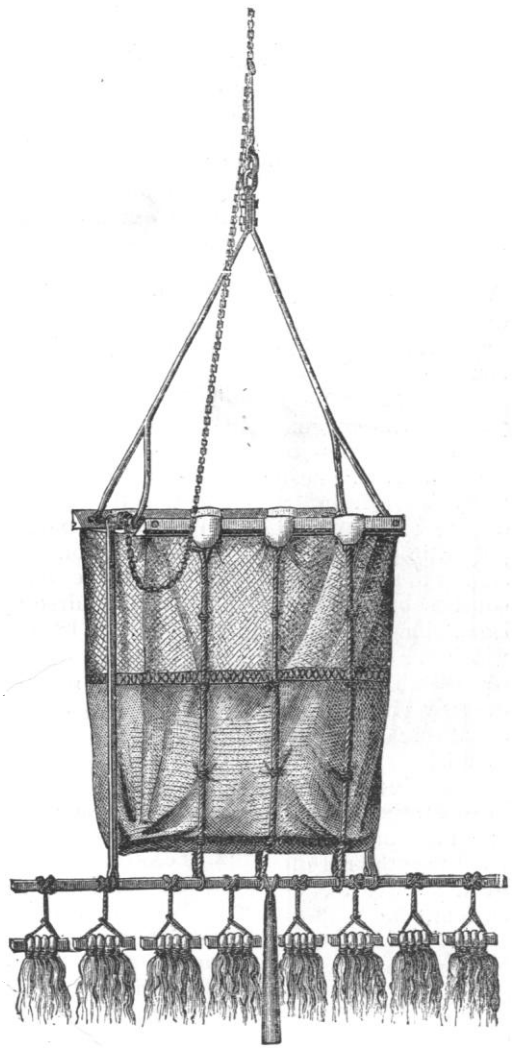

FIG. 6.—THE CHALLENGER'S DREDGE.
(*From 'The Atlantic.'*)

far better ones followed the completion of the flat frame, which was soon afterwards constructed, and used during the remainder of the cruises.

The Blake dredge, as it is called, was devised by Commander Sigsbee, U.S.N., and Master Jacoby, U.S.N.; the "object sought in the fashioning of the new dredge" having been, according to the account of Mr. Sigsbee, "to effect a skimming of the bottom rather than a deep penetration therein." Its essential features (as shown in fig. 7) are its broad, non-flaring scrapers, and rectangular iron frame or 'skeleton box' outlining its entire shape, the entire framework being rigidly joined together. These cause it to rest flat upon the bottom, and prevent its digging in beyond a slight depth. The small quantity of mud which enters at a time is being constantly washed from the net, to a greater or less extent, by the force of the water passing through it, leaving only the coarser portions and the specimens behind. When a sample of the fine bottom-material is desired, the lower part of the net is lined with some open-mesh cloth, like muslin or scrim.

The length of the frame is about four feet, the width about three feet, and the depth nine inches. The scrapers are six inches wide and three-fourths of an inch thick, being bevelled on the inner faces at the front to form sharp edges. The net, constructed of twine webbing, hangs loosely within the frame, over which a canvas covering is fastened for its protection. As used by the Blake, a transverse bar of wood or iron, for the attachment of weights and tangles, was secured to three sister-hooks at the hinder end of the frame.

This form of dredge has since been adopted by the fish-commission for deep-sea explorations, and often replaces the simple frame and net used in connection with the Chester rake-dredge described below.

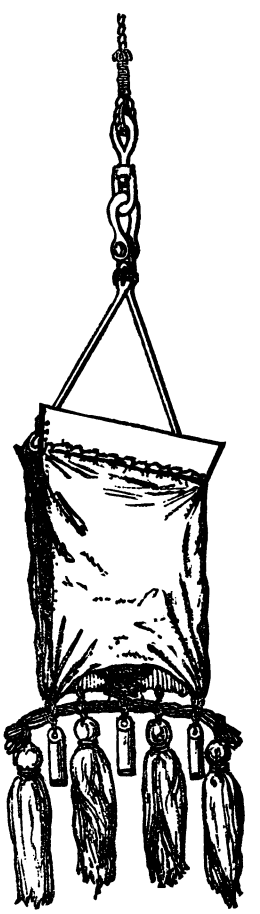

FIG. 7.—FIRST FORM OF THE BLAKE DREDGE.
(*From Sigsbee's 'Deep-sea sounding.'*)

Rake-dredges.

In 1871 Prof. A. E. Verrill, in immediate charge of the dredging operations of the U. S. fish-commission, conceived the idea of supplementing the work of the common dredge by the

use of a greatly modified form, called the rake-dredge, the object of which is to dig deeply into

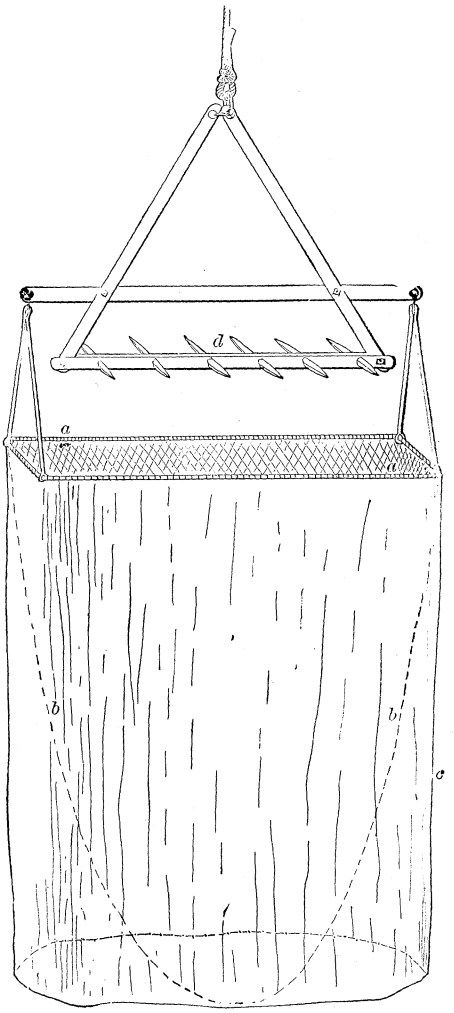

FIG. 8. — VERRILL'S RAKE-DREDGE.

the bottom, and unearth the many burrowing forms of marine invertebrates which are rarely taken in the old pattern.

This apparatus consists of a triangular frame of flat-bar iron, each side measuring forty-two inches in length. The hinder portion of the frame, which is three feet long, is constructed of two bars placed face to face, each furnished with six strong iron or steel teeth, about a foot in length, on opposite sides. These teeth, therefore, project in opposite directions; and the frame is reversible in use, working either side down. It is also so bolted together that it can be folded up for convenience in transportation. From a crossbar near the hinder end of the frame, there is suspended a capacious net, which trails behind. The mouth-frame of this net is made of round iron.

This implement, therefore, consists essentially of a large dredge, not furnished with scrapers, but preceded by a stout rake or harrow. The character of the work which it is intended to perform is obvious, and the many interesting forms which it has added to the collections of the fish-commission have caused it to be considered one of the most important additions to the dredger's outfit. It can, however, be used only on smooth muddy or sandy bottoms, and requires considerable force to drag it through compact mud or sand.

The same form of rake-dredge, without alteration or improvement, was adopted by the French exploring-steamer Talisman in 1883.

Capt. H. C. Chester of the fish-commission party devised, in 1880, a new form of rake-dredge (fig. 9), which is now generally employed in place of the old pattern. The net is similar to the one above described; but the rake consists of a heavy rectangular frame of flat iron, along the opposite and longer sides of which the teeth are arranged, projecting outwards. The rake-frame measures three feet long by nine inches wide; and the teeth are about eight inches long, stout, curved, and pointed.

The principal improvement claimed consists in separating the two rows of teeth so that the upper row may not interfere with passage backward into the net of the larger objects dug up by the lower teeth as they scrape along the bottom.

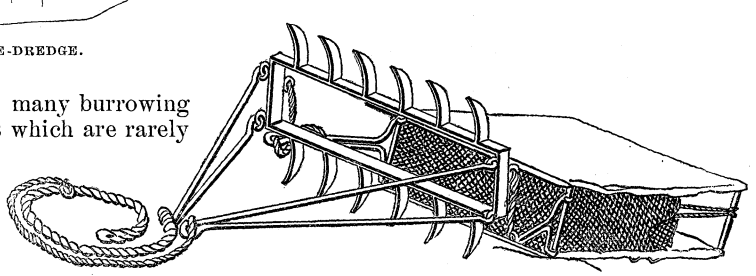

FIG. 9. — CHESTER'S RAKE-DREDGE.

An ingenious pattern of rake-dredge, intended for collecting small forms of invertebrates in shallow water, was invented in 1880 by Mr. James E. Benedict of the same party. As represented in fig. 10, it consists of a double

rake, and a cylinder of galvanized sheet-iron, thirty inches long by eleven inches in diameter, containing an elongate, tapering strainer, and supported in an iron framework having six runners of round iron at equal distances apart. The mouth is furnished with a short conical strainer of coarse wire netting projecting from the front, and a funnel-shaped collar of sheet-iron opening inwards. This dredge is designed for collecting the small, unattached forms of marine animals living upon smooth bottoms,

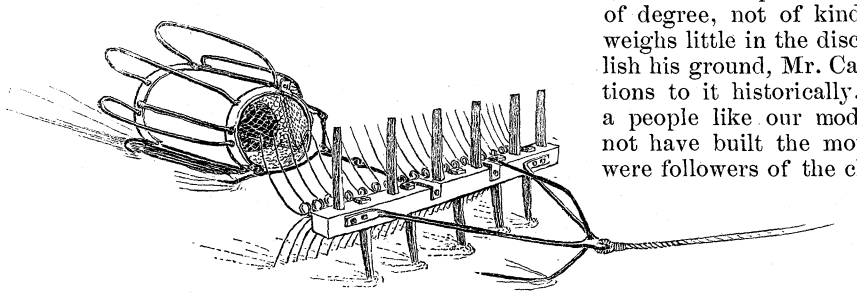

FIG. 10. — BENEDICT'S RAKE-DREDGE.

which are crushed or lost sight of in the ordinary dredges and trawls. The rake is intended to give the bottom-materials a thorough stirring up, so as to dislodge the animals, which, together with the sediment, come in contact with the nose-piece of the cylinder, only those below a certain size being able to pass in. This appliance has proved very effective in collecting in perfect condition many delicate species of animals which had previously been seldom obtained in suitable shape for study, and at the recent London fisheries exhibition it elicited much favorable comment from European naturalists.

RICHARD RATHBUN.

THE ORIGIN OF THE OHIO MOUNDS.

The mounds of the Mississippi valley historically considered. By LUCIEN CARR, assistant curator of the Peabody museum of American archaeology. [From vol. ii. of the *Memoirs of the Kentucky geological survey.* N. S. Shaler, director.] 1883. 109 p. 4°.

THE thesis which Mr. Carr has to defend in this elaborate paper is that the red Indian, as he is known historically, and without implying any lapse from a higher condition of life than he now occupies, was quite capable of building the mounds of the Mississippi valley. As we have no positive proof of what the people were who did build them, and no record of the time of building, except inferentially in some cases from the rings of trees, he claims that there is no necessity of supposing them the work of other folk than those found upon the spot by the whites at the first contact. Further, should, by any chance, evidence be found hereafter to fix the so-called mound-builder as another race, there is no ground to believe them to be higher in the social scale than the red Indian of historic times. He admits that in size the Ohio mounds, in some cases, exceed those which the Indian is actually known to have built in recent times; but in his opinion the difference is one of degree, not of kind, and accordingly weighs little in the discussion. To establish his ground, Mr. Carr meets the objections to it historically. It is urged that a people like our modern Indians could not have built the mounds, because they were followers of the chase, and not agriculturists; and without being agriculturists they could not have supplied the subsistence for the large number of men necessary to erect these mounds. There are two ways of answering this proposition. One is by asserting that there is no evidence that the building was done in such a way as to require much labor in a short time; while it may be believed that the labor was extended over a long time, and hence required few workers at any one time. This answer Mr. Carr ignores. The other reply is, that it is an unfounded assumption to affirm that the red Indian was not an agriculturist, when it is susceptible of proof that he not only supplied from the fields daily wants, but laid in store for unfruitful years and for barter. This position Mr. Carr abundantly sustains from the older writers.

The second proposition which he meets sets forth the so-called mound-builders as worshippers of the sun, and their structures as inferentially allied with that cult; while the Indian is not and was not such a worshipper. His answer to this is, that the red Indian is, and particularly was, a sun-worshipper; and this he establishes satisfactorily from the early chroniclers. Further, it is a mere assumption, in his opinion, to call a certain class of these mounds religious while there is no proof of it. The truth seems to be, that designations of convenience have grown to be arguments obscuring the question.

Having thus in two sections of his paper proved that the Indian could have built such